Rock Chips

Fall 2011

Alberta Geological Survey

Alberta Geological Survey and Alberta Environment Release the Edmonton–Calgary Corridor Groundwater Atlas

The Government of Alberta is committed to working with Albertans to ensure that we all have access to a healthy, secure and sustainable water supply. To accomplish this, Albertans were involved in drafting an important strategy. The original *Water for Life* strategy, released in November 2003, established three main goals for managing and safeguarding our water resources:

- safe, secure drinking water;
- healthy aquatic ecosystems; and
- reliable, quality water supplies for a sustainable economy.

With these goals in mind, Alberta Environment and the Energy Resources Conservation Board/Alberta Geological Survey began a cross-ministry plan to inventory Alberta's groundwater resources. The first area of study was the Edmonton-Calgary Corridor (ECC). This part of the province, which already had some of the highest groundwater use in Alberta, continues to undergo population and industrial growth. In recognition of this increasing stress on the water system in the ECC, understanding the inventory of groundwater resources in the region has become important so that appropriate water-management decisions can be made. The first phase of our work is being released in the form of an atlas that provides information on the geology, hydrology and hydrogeology of the study area.

ERCB Energy Resources Conservation Board | AGS Alberta Geological Survey

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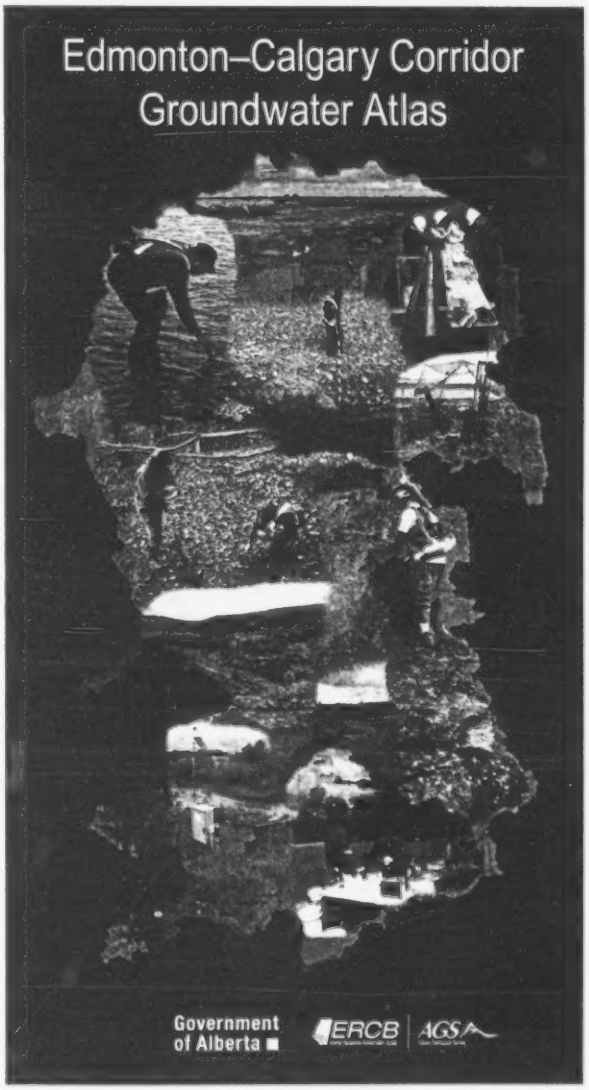

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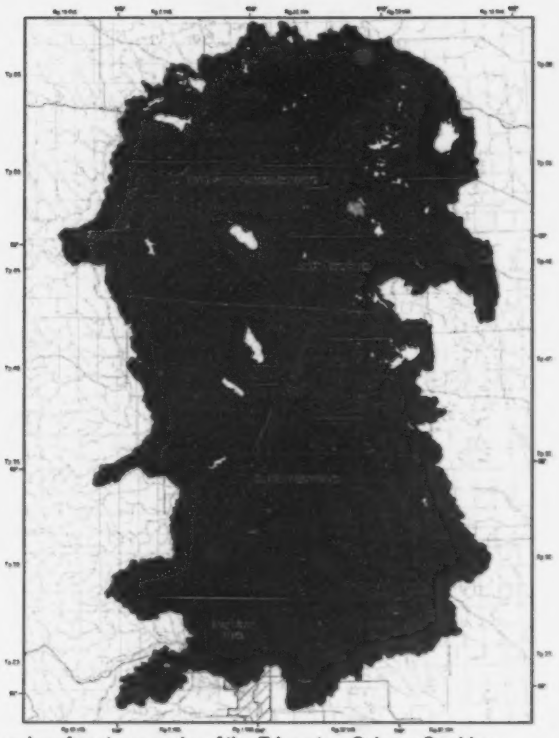

Land-surface topography of the Edmonton-Calgary Corridor. Elevations are highest in the southwest decreasing toward the northeast.

Study Area – Geology

The geological history of the ECC is marked by the

- building of mountains;
- eruption of volcanoes;
- flooding of the land by seas, with subsequent retreat of those waters;
- development of vast swamps;
- effects on the landscape of large, ancient river systems;
- advance and melting of glaciers;
- current effects of rivers, streams, wind and precipitation on the landscape; and
- current effects people have on the landscape.

We compiled and mapped information on the geological history of the ECC by building models of the bedrock units and of the sediments above bedrock. These models helped us understand more about the container that groundwater is moving through and to predict where the largest volumes of groundwater can be found.

Rock Chips is published four times a year by the Alberta Geological Survey in the spring, summer, fall and winter.

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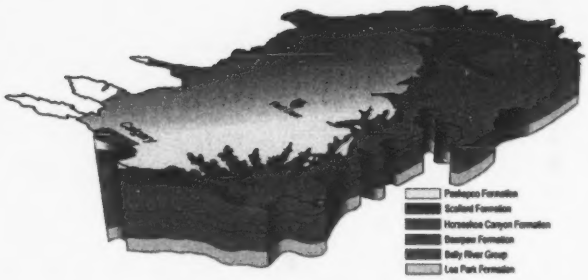
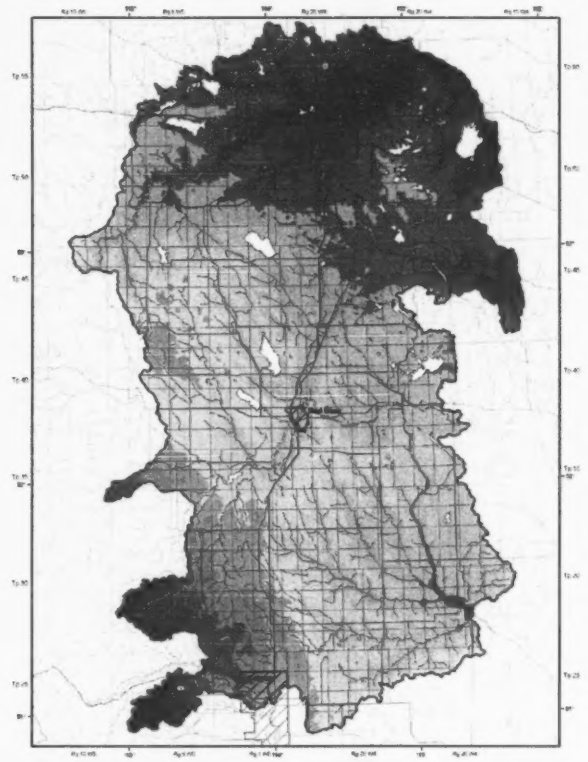
Staff may also be contacted via e-mail by entering the author's first name.last name@ercb.ca

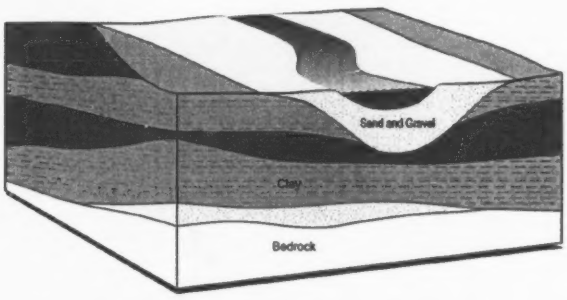
Comments and suggestions for Rock Chips may be sent to Maryanne Protz at maryanne.protz@ercb.ca



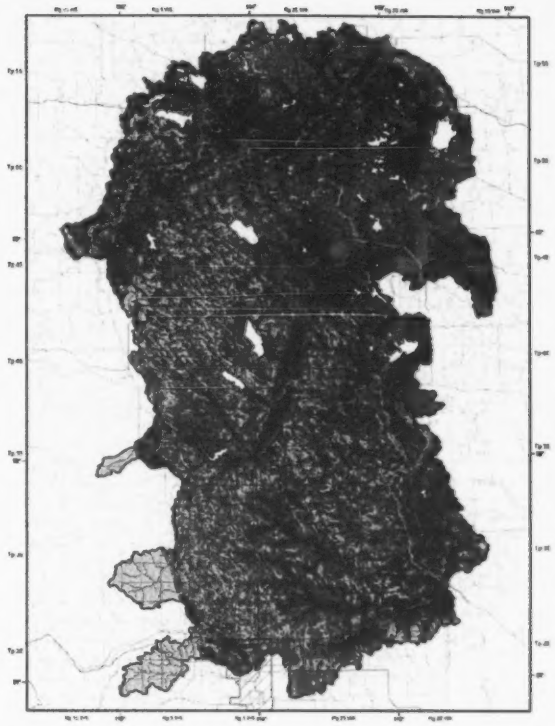
Model of the bedrock units in the Edmonton–Calgary Corridor.



Bedrock top-surface topography of the Edmonton-Calgary Corridor. Elevations are highest in the southwest decreasing toward the northeast.



Block diagram showing how sediments above bedrock may look in three-dimensional space.

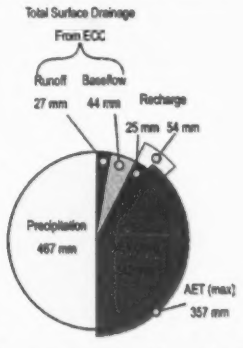


Thickness of sediments above bedrock. Areas of dark brown represent areas of thickest sediment accumulations.

Study Area – Hydrology

The 3rd edition of the Dictionary of Geological Terms defines hydrology as, "The science that deals with global water (both liquid and solid), its properties, circulation, and distribution, on and under the earth's surface and in the atmosphere, from the moment of its precipitation until it is returned to the atmosphere through evapotranspiration or is discharged into the ocean."

We worked on understanding the circulation and distribution of water in the ECC by analyzing climate data, such as precipitation and air temperature, as well as data on stream flow and near-surface geology. The result was a water budget for the ECC.



Pie chart showing the components of the water budget for the ECC.

Study Area – Hydrogeology

Hydrogeology is a subdiscipline of hydrology and geology focusing on subsurface water. It is typically subdivided into physical hydrogeology and chemical hydrogeology. Physical hydrogeology is the study of physical properties of the groundwater system, including how groundwater enters and moves through the earth, and of the properties of the units water is moving through, like porosity and permeability. Chemical hydrogeology is the study of how and why water chemistry changes as groundwater moves through the earth.

Physical Hydrogeology

Physical hydrogeology focuses on

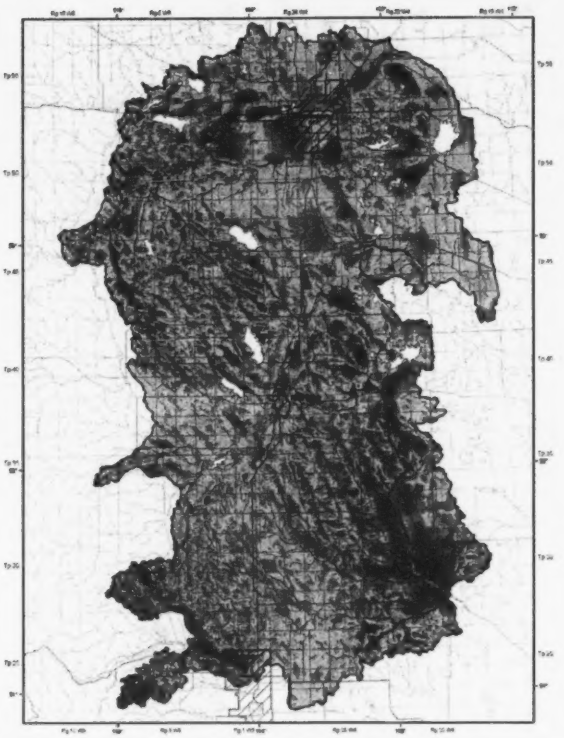
- how water enters the subsurface;
- how it moves through the earth;
- where aquifers are and how big they are;
- what the permeability and porosity of sediments or rocks are;
- where groundwater exits the subsurface;
- how pumping water out of the subsurface affects the water system as a whole; and
- where groundwater resources may be susceptible to contamination.

Our work provided an overview of these aspects of hydrogeology. We mapped zones where water enters and exits the groundwater system, how groundwater moves within this system, the properties of subsurface sediments and rocks and an estimate of aquifer susceptibility within the ECC.

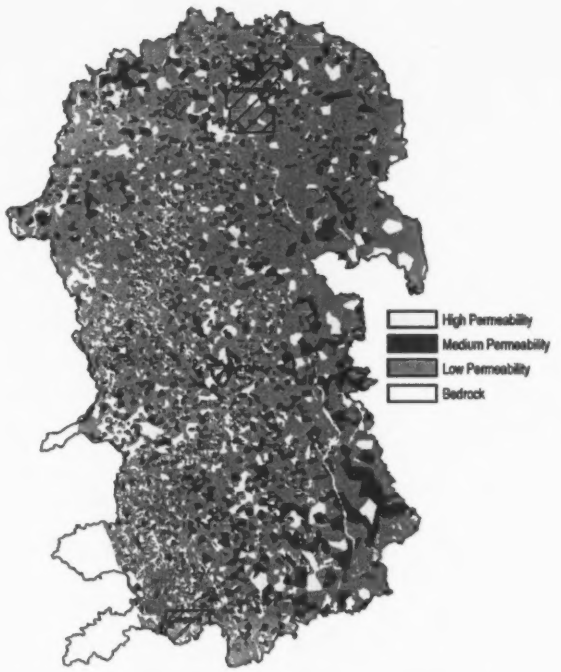
Chemical Hydrogeology

Water enters the near-surface groundwater system as rain infiltrates the ground and travels down past the water table. Groundwater will then migrate from its recharge area toward its discharge area. This water is initially low in dissolved mineral content, but as it moves through the earth, the water changes its chemical composition as it interacts with minerals and gases in the subsurface, increasing the amount of dissolved content in the water over time. Additional geochemical processes along groundwater-flow paths control the final water composition.

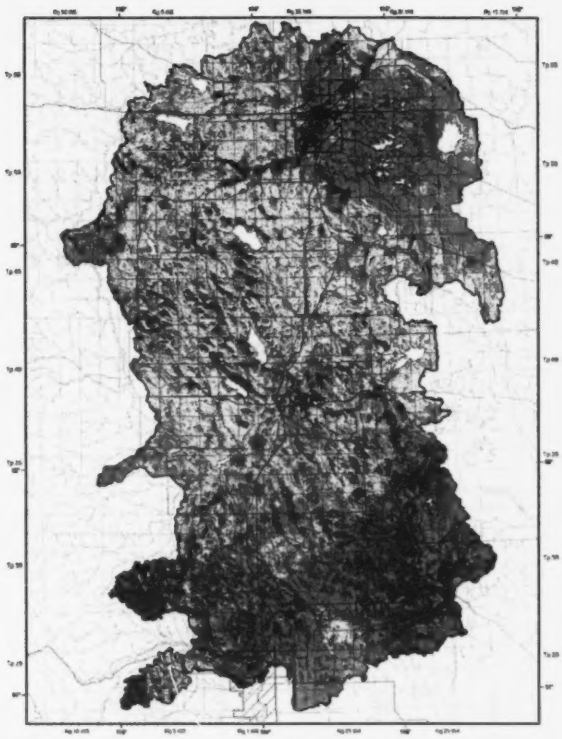
We focused on providing a general overview of the chemical hydrogeology of the ECC, showing how the water chemistry changed within and between the geological units that we mapped. We detected some



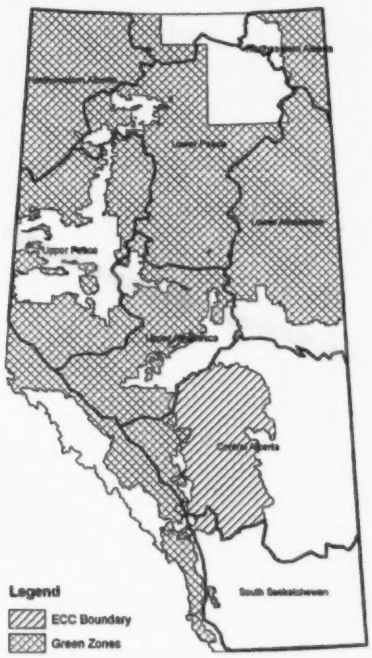
Zones of local recharge (green) and zones of local discharge (red). Darker colours represent greater amounts of recharge or discharge.



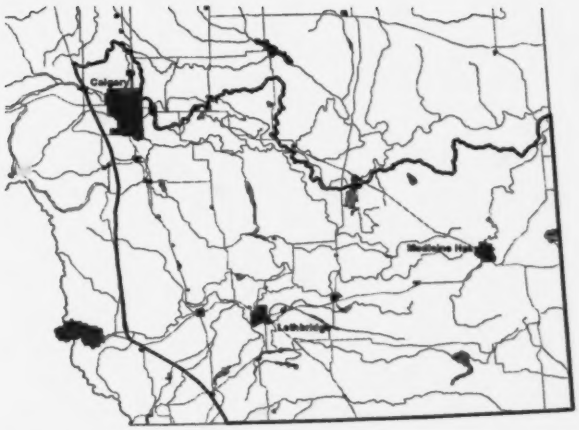
The permeability of the sediments above bedrock at five metres below ground surface as determined by water-well lithologs.



Results of the DRASTIC groundwater susceptibility assessment. Red areas are high susceptibility, orange areas are medium susceptibility, yellow areas are moderately low susceptibility, green areas are low susceptibility, blue-green areas are very low susceptibility, and blue areas have an extremely low susceptibility.



Proposed areas to be mapped as part of the provincial Groundwater Inventory Program (indicated by blue outlines).



Outline of the next study area, the south Saskatchewan River Basin.

changes in water chemistry between recharge and discharge areas, as well as variations occurring due to changes in depth.

We have already begun geological mapping in our next study area, the South Saskatchewan River Basin. Once the mapping is completed, we will release a similar groundwater atlas for this area. The ultimate goal is to deliver atlases for all of our proposed study areas to complete a provincial groundwater inventory.

With the completion of this phase of groundwater mapping in the ECC, we took important steps toward furthering the goals of the *Water for Life* strategy and establishing the methods we will use to fully understand Alberta's groundwater resources. ❖

CanGeoRef Launched

Canadian Federation of Earth Sciences | *Fédération canadienne des sciences de la Terre*

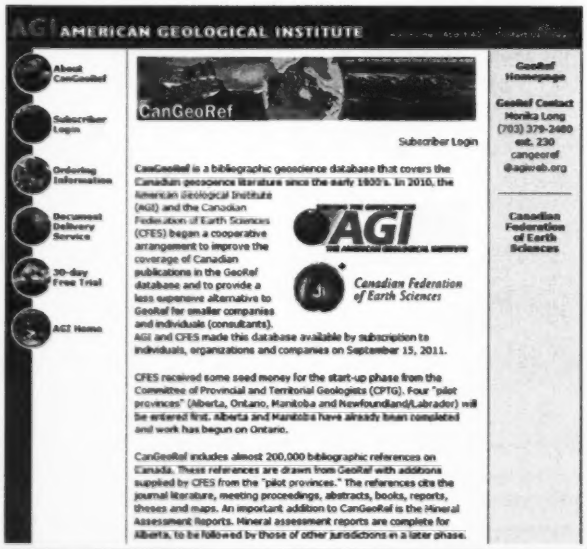
The American Geological Institute (AGI) and the Canadian Federation of Earth Sciences (CFES) launched CanGeoRef on September 15, 2011. CanGeoRef is a bibliographic database covering the Canadian geoscience literature from the early 1800s.

With seed money from the Committee of Provincial and Territorial Geologists, CFES, in cooperation with the Canadian provincial and territorial geological surveys, obtained publication data to be added to the existing Canadian references drawn from GeoRef (AGI's global bibliographic database for geoscience). Data have already been added for Alberta and Manitoba and Ontario is near completion. Newfoundland and British Columbia will follow shortly.

CanGeoRef contains almost 200 000 bibliographic references on Canada. These include citations to the journal literature, meeting proceedings and abstracts, books, reports, theses and maps.

During Phase 1 of the project, provincial and territorial publications are being added. Phase 1 should be finished by 2013. Subscription rates will be discounted while data entry is completed. Phase 2 will consider including provincial and territorial mineral assessment reports. Currently, only mineral assessment reports for Alberta have been added.

http://www.agiweb.org/georef/cangeoref/index.html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CanGeoRef is a bibliographic geoscience database that covers the Canadian geoscience literature since the early 1800's. In 2010, the American Geological Institute (AGI) and the Canadian Federation of Earth Sciences (CFES) began a cooperative arrangement to improve the coverage of Canadian publications in the GeoRef database and to provide a less expensive alternative to GeoRef for smaller companies and individuals (consultants).
AGI and CFES made this database available by subscription to individuals, organizations and companies on September 15, 2011.
CFES received some seed money for the start-up phase from the Committee of Provincial and Territorial Geologists (CPTG). Four "pilot provinces" (Alberta, Ontario, Manitoba and Newfoundland/Labrador) will be entered first. Alberta and Manitoba have already been completed and work has begun on Ontario.
CanGeoRef includes almost 200,000 bibliographic references on Canada. These references are drawn from GeoRef with additions supplied by CFES from the "pilot provinces." The references cite the journal literature, meeting proceedings, abstracts, books, reports, theses and maps. An important addition to CanGeoRef is the Mineral Assessment Reports. Mineral assessment reports are complete for Alberta, to be followed by those of other jurisdictions in a later phase.
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GeoRef Contact
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ext. 230
cangeoref@agiweb.org
Canadian Federation of Earth Sciences

Meet Our Staff
Christopher Banks' Geologist

How long have you been with AGS?
Two years

What is your field of expertise?
Clastic sedimentology and geomodelling.

What is your professional claim to fame?
I won the Clough Award for the "most outstanding contribution to the geology of the Northern Britain." This was for my work in the metamorphic rocks that underlie the Central Highlands, Scotland. These metasedimentary rocks had been mostly the preserve of 'hard-rock' geologists (e.g., petrologists, structural geologists, geochronologists and geochemists). I looked through the tectonic and metamorphic overprint, where possible, and applied the 'soft-rock' principles of stratigraphy and sedimentology to these rocks. Many problems of Highland geology went away when you viewed the rocks in the context of their original depositional basins.

Where is the most interesting place on Earth that you have worked?
Kuala Lumpur. I was undergoing training on oil-industry consulting with Schlumberger Information Solutions. It was both culturally and professionally very different and very interesting!

What is your favourite geological place/feature in Alberta?
That would have to be the hoodoos

Why did you pick your career?
I didn't, it kind of creeped up on me whilst I had intended on being a geography teacher!

Publications

http://www.ags.gov.ab.ca/publications

Open File Reports

OFR 2011-02 Measured Outcrop Section T21-R10W4-01 of the Oldman and Dinosaur Park Formations (Belly River Group), Dinosaur Provincial Park Area, Red Deer River Valley, Southeastern Alberta (NTS 72L/14)

OFR 2011-03 Measured Outcrop Sections T2-R6W4-01 and T2-R6W4-02 of the Foremost and Oldman Formations (Belly River Group), Pinhorn Provincial Grazing Reserve, Milk River Valley, Southeastern Alberta (NTS 72E/02)

OFR 2011-04 Measured Outcrop Section T17-R3W4-01 of the Foremost, Oldman and Dinosaur Park Formations (Belly River Group), White Rock Coulee, South Saskatchewan River Valley, Southeastern Alberta (NTS 72L/08)

OFR 2011-06 Measured Outcrop Section T13-R9W4-01 of the Foremost and Oldman Formations (Belly River Group), Suffield Area, South Saskatchewan River Valley, Southeastern Alberta (NTS 72L/03)

OFR 2011-07 Measured Outcrop Section T27-R17W4-01 of the Bearpaw and Horseshoe Canyon Formations, Dorothy, Red Deer River Valley, Southern Alberta (NTS 72P/08)

OFR 2011-08 Tops of the Horseshoe Canyon, Wapiti and Battle Formations in the West-Central Alberta Plains: Subsurface Stratigraphic Picks and Modelled Surface

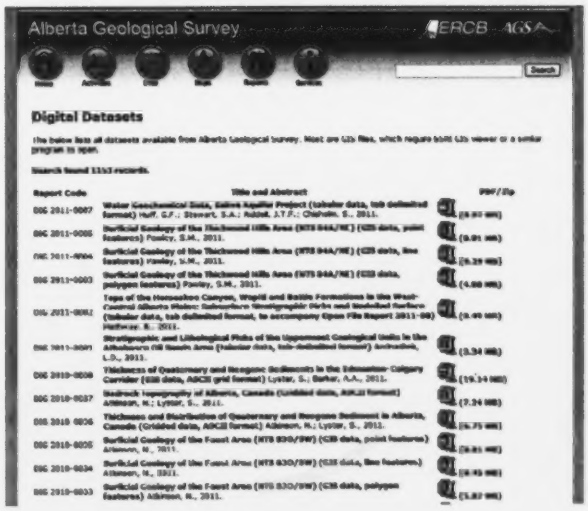
Digital Datasets

DIG 2011-0002 Tops of the Horseshoe Canyon, Wapiti and Battle Formations in the West-Central Alberta Plains: Subsurface Stratigraphic Picks and Modelled Surface (tabular data, tab delimited format, to accompany Open File Report 2011-08)

Information Series

INF 140 Edmonton–Calgary Corridor Groundwater Atlas

We've updated our navigation bar at www.ags.gov.ab.ca to include a data button. You can now get to our datasets in one click.



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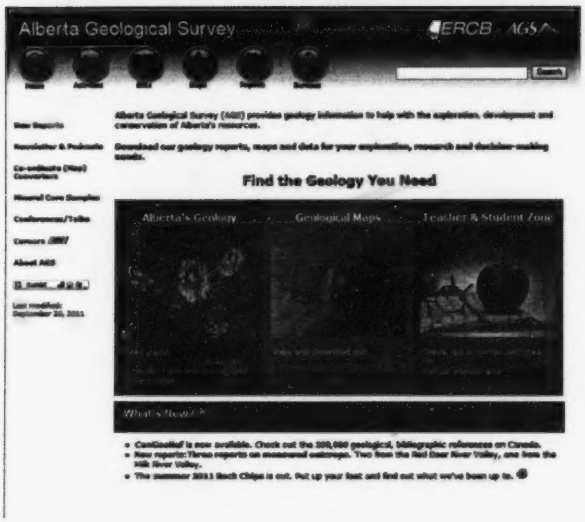

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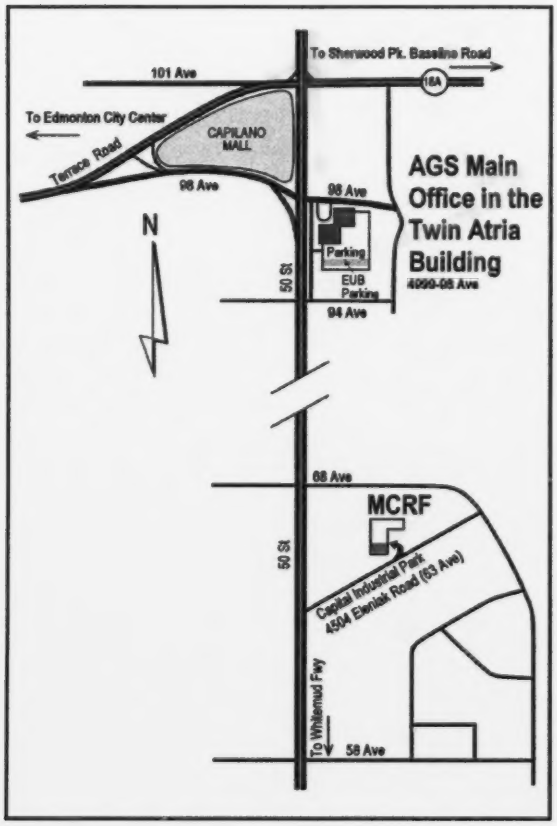

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For information on the MCRF or to book a visit, contact Rob Natyshen at (780) 466-1779 or Rob.Natyshen@ercb.ca